OPTICAL COMPENSATION SHEET, ELLIPTICAL POLARIZING PLATE, AND LIQUID CRYSTAL DISPLAY DEVICE

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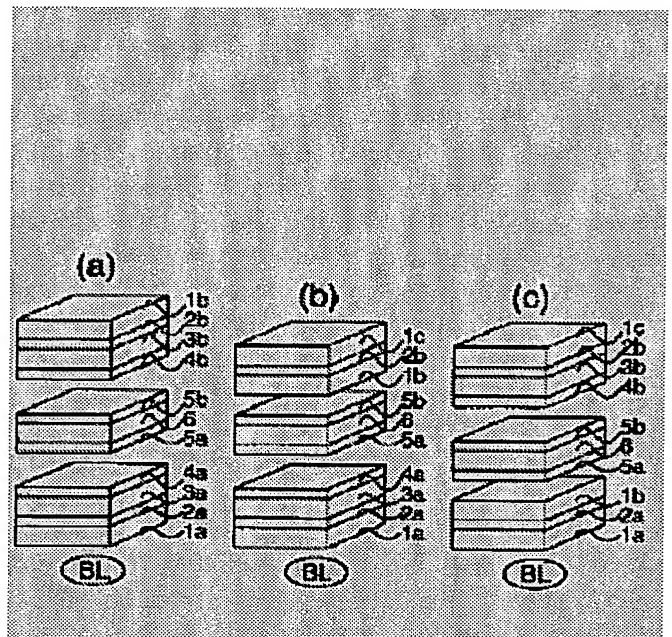
Abstract of **JP2000304932**

PROBLEM TO BE SOLVED: To make effectively and optically compensable a liquid crystal cell by aligning rodlike liquid crystal molecules in a state having a specified average tilt angle of the major axial direction of the rodlike liquid crystal molecules and the face of a transparent supporting body.

SOLUTION: A transmission type liquid crystal display device as an example consists of, in order from the back light BL side, a transparent protective film 1a, a polarizing film 2a, transparent supporting body 3a, an optical anisotropic layer 4a, the lower substrate 5a of a liquid crystal cell, rodlike liquid crystal molecules 6, the upper substrate 5b of the liquid crystal cell, an optical anisotropic layer 4b, a transparent supporting body 3b, a polarizing film 2b, and a transparent protective film 1b. The transparent supporting body and optical anisotropic layer (3a to 4a, 4b to 3b) form an optical compensation sheet, and the transparent protective film, polarizing film, transparent supporting body and optical anisotropic layer (1a to 4a, 4b to 1b) form an elliptical polarizing plate. In this case, the optical anisotropic layers 4a, 4b consist of rodlike liquid crystal molecules 6. The rodlike liquid crystal molecules 6 are aligned at <5 deg. average tilt angle between the major axial direction of the rodlike liquid crystal molecules 6 and the faces of the transparent supporting bodies 3a, 3b.



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(54) [Title of the invention] OPTICAL COMPENSATORY SHEET, ELLIPTICALLY POLARIZING PLATE AND LIQUID CRYSTAL DISPLAY

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[CLAIMS]

[Claim 1] An optical compensatory sheet comprising a transparent support and an optically anisotropic layer formed of rod-like liquid crystal molecules, wherein the rod-like liquid crystal molecules are aligned at an average inclined angle of less than 5° between a long-axis direction of the rod-like liquid crystal molecules and a plane of the transparent support.

[Claim 2] The optical compensatory sheet according to claim 1, wherein the transparent support has an optical uniaxiality or an optical biaxiality.

[Claim 3] The optical compensatory sheet according to claim 2, wherein an in-plane slow axis of the transparent support and an average direction of a line obtained by projecting the long-axis direction of the rod-like liquid crystal molecules on the transparent support plane are substantially parallel or perpendicular to each other.

[Claim 4] The optical compensatory sheet according to claim 1, further comprising a second optically anisotropic layer formed of rod-like liquid crystal molecules, and also in the second optically anisotropic layer, the rod-like liquid crystal molecules are aligned at an average inclined angle of less than 5° between the long-axis direction of the rod-like liquid crystal molecules and a plane of the transparent support.

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[0013] [Optically anisotropic layer] The optically anisotropic layer is formed of rod-like liquid crystal molecules. The rod-like liquid crystal molecules are aligned at an average inclined angle of less than 5° between the long-axis direction of the rod-like liquid crystal molecules and a plane of the transparent support. It is preferable that the retardation of the entire optical compensatory sheet is controlled by means of the optical anisotropy of the optically anisotropic

layer. It is preferable that an in-plane retardation (Re) of the entire optical compensatory sheet is from 20 to 200 nm, more preferably, from 20 to 100 nm, and most preferably, from 20 to 70 nm. It is preferable that a thickness direction retardation (Rth) of the entire optical compensatory sheet is 70 to 500 nm, more preferably, 70 to 300 nm, and further preferably, 70 to 200 nm. The in-plane retardation (Re) and the thickness direction retardation (Rth) of the optical compensatory sheet are defined respectively by the following formulae.

$Re = (nx - ny) \times d$

$Rth = [\{(nx + ny)/2\} - nz] \times d$

In the formulae, nx and ny denote in-plane refractive indices of the optical compensatory sheet, nz denotes a thickness direction refractive index of the optical compensatory sheet, and d denotes a thickness of the optical compensatory sheet.

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[0016] Depending on a display mode of the liquid crystal cell, the rod-like liquid crystal molecules can be aligned in a cholesteric manner. When the rod-like liquid crystal molecules are aligned in a cholesteric manner, the selective reflection range is preferred to be out of the visible range. Examples of preferably used rod-like liquid crystal molecules include azomethines, azoxys, cyanobiphenyls, cyanophenyl esters, benzoates, cyclohexane carboxylic acid phenyl esters, cyanophenyl cyclohexanes, cyano-substituted phenyl pyrimidines, alkoxy-substituted phenyl pyrimidines, phenyl dioxanes, tolans, and alkenyl cyclohexyl benzonitriles. Metal complexes are also included in examples of the rod-like liquid crystal molecules. Liquid crystal polymers including rod-like liquid crystal molecules in its repeating units can be used also as the rod-like liquid crystal molecules. In other words, the rod-like liquid crystal molecules can be bound to (liquid crystal) polymers. Such rod-like liquid crystal molecules are described in *Kikan Kagaku Sosetu* (Survey of Chemistry, Quarterly) (No. 22: 'Liquid Crystal Chemistry', 1994, Chapters 4, 7, and 11, edited by Chemical Society of Japan), and *Ekisho Device Handbook* (Handbook of Liquid Crystal Device) (Chapter 3, edited by the 142nd Board of Japan Society for Promotion of Science). It is preferable that the rod-like liquid crystal molecules have a birefringence of 0.001 to 0.7. It is preferable that the rod-like liquid crystal molecules have polymerizable groups. Examples of the polymerizable groups (Q) are shown below.

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[0035] Depending on the type of the liquid crystal display mode, an optically anisotropic polymer film can be used for the transparent support. That is, in some cases, optical anisotropy of a transparent support will be added to the optical anisotropy of the optically anisotropic layer in order to correspond (optically compensate) to the optical anisotropy of the liquid crystal cell. In such a case, it is preferable that the transparent support has an optical uniaxiality or an optical biaxiality. For a case of an optically uniaxial support, the optical axiality can be positive (i.e., the refractive index in the optical axis direction is larger than the refractive index in a direction perpendicular to the optical axis) or can be negative (i.e., the refractive index in the optical axis direction is smaller than the refractive index in a direction perpendicular to the optical axis). For a case of an optically biaxial support, the refractive indices nx, ny and nz in the above formulae are values different from each other ($nx \neq ny \neq nz$). It is preferable that the in-plane retardation (Re) of the optically anisotropic transparent support is from 10 to 1000 nm, more preferably, from 15 to 300 nm, and most preferably, from 20 to 200 nm. It is preferable that the thickness direction retardation (Rth) of the optically anisotropic transparent support is from 10 to 1000 nm, more preferably, from 15 to 300 nm, and further preferably, from 20 to 200 nm.